

BIM Enables Early Design Energy Analysis

By Annette Stumpf and Beth Brucker

Building Information Modeling (BIM) offers yet another powerful capability to design teams: they can assess alternative energy strategies and systems in the earliest phases of design. New and emerging tools allow a user to submit data from project BIMs to test energy-saving ideas and see results quickly. This will help teams make energy-conscious decisions early in design – when those decisions have greatest impact on the building's life cycle. This capability will also help project teams make cost-effective retrofit decisions (e.g., how many inches of rigid insulation to place on a roof for a re-roofing project).

As the U.S. Army Corps of Engineers transitions to a BIM-enabled business process, the software industry is experiencing a concurrent surge in the development of energy analysis tools and interoperable formats. This climate creates new opportunities for building analysis by pairing BIM and analysis software to assess building performance.

For decades, energy simulation software tools have been available to assist in designing energy-efficient buildings. However, most building energy analysis is conducted late in design, when other building features cannot be changed. The ability to model energy decisions early in the design process, and then choose the best alternative, is not fully exploited due to the difficulty and expense of modeling the building and energy systems after the design is complete.

New tools use BIM input

Several software vendors are now providing tools to conduct energy analyses by taking advantage of the data contained in BIM. The current products each have advantages and drawbacks.

Stand-alone energy analysis/simulation tools have been available for years, but it is typically a costly, labor-intensive process to



*Army Reserve Training Center modeled in BIM.
(Courtesy Louisville District BIM team)*

recreate the building model for analysis; hence, these tools are mostly used late in the design process for finalizing or documenting energy decisions.

The Industry Foundation Class (IFC) file exchange format can be exported from the BIM environments for input into energy analysis tools, but there are also some limitations in this process — one being that current BIM models do not contain all the information necessary for energy modeling. Also, the export to IFC may lose some important energy-related building data. BIM software vendors and standards organizations, such as the International Alliance for Interoperability (IAI) and the National Building Information Modeling Standard (NBIMS) groups, are addressing these issues.

Embedded energy analysis tools are currently being integrated into several of the BIM software environments. This approach eliminates the need to import and export building geometry and data through IFC or other formats. However, it incurs a cost for maintaining the energy software as new versions of the BIM software environments are released.

The *Green Building XML (gbXML)* file format is being adopted by many in the heating, ventilating and air-conditioning (HVAC)

industry (including Trane, Carrier & York International) in attempts to streamline the building design process and provide improved interoperability for project design teams. Several of the leading BIM applications enable users to create BIM output in the gbXML format (including Autodesk, Graphisoft, Bentley Systems, Elite Software, ECOTECT and GeoPraxis).

[Green Building Studio](#), a web-based service that works with a gbXML file exported from various BIM applications, uses the building information to perform an energy evaluation with established tools such as DOE-2, eQuest, and EnergyPlus. Its "Design Alternatives" feature quickly analyzes the building to determine which option is the most energy-efficient by demonstrating various changes to the building design such as orientation, glazing options, envelope constructions, lighting, and HVAC.

Test planned for Corps project

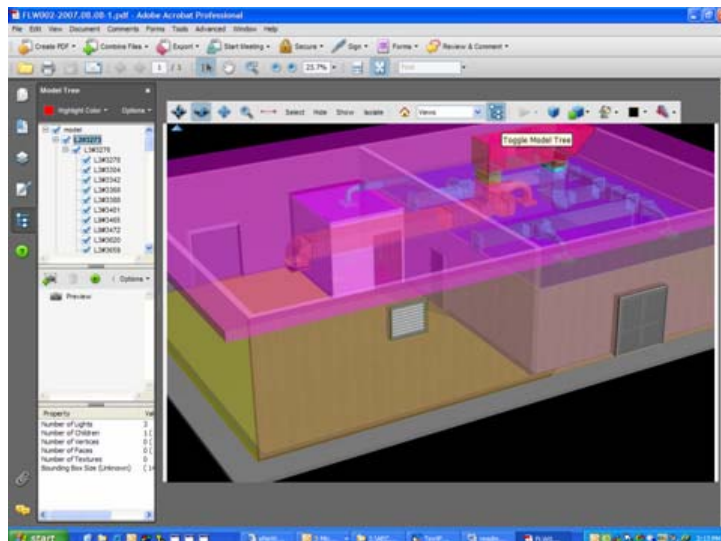
The private sector has been experimenting with using BIM to run energy models but there are no known applications in the Army to date. Working with one of the Corps' Design Centers of Standardization, the Engineer Research and Development Center (ERDC) plans to test Green Building Studio during an actual project in FY08 (January '08 timeframe). The goal will be to keep

30 percent energy savings mandated by the Energy Policy Act of 2005. If the test is successful, ERDC will provide guidance for the Army's adoption of Early Design and Energy Analysis using BIM, which will improve the energy efficiency of all its future buildings and retrofits.

According to Richard Grulich, chief of the Architectural Branch at Huntsville Engineering and Support Center, "One of my greatest design experiences has been our introduction to BIM. Our first BIM design for a medium size child care center is affording a unique opportunity to incorporate early LEED planning into the three-dimensional model. The working drawing aspect of BIM also identifies quantities and cost projections. The missing component is an energy analysis tool that can be used when the building envelope is developed within the first three weeks of the project. Testing different geometries, orientation and envelope insulation scenarios will save time and design rework costs."

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HVAC modeling in BIM. (Courtesy Seattle District BIM team)
